# COMPARING BATSMEN ACROSS DIFFERENT ERAS: THE ENDS OF THE DISTRIBUTION JUSTIFYING THE MEANS

by

H. Shelton Brown

No. 289

May 2001

**Editor of DISCUSSION PAPERS IN ECONOMICS:** **Dr Mohammad Alauddin**

**Editorial Advisers:**
Professor Harry Campbell, Dr. R. Cage, A/Professor Darrel Doessel, Mr. Alan Duhs, Professor John Foster, Professor Rod Jensen, Dr. Bruce Littleboy, Dr. Tom Riha, Dr. Jon Stanford plus other staff members in Economics

**Address:** School of Economics
The University of Queensland
Queensland 4072 Australia

**Telephone:** (07) 3365 4482
**Fax:** (07) 3365 7299
**Email:** a.lindley@economics.uq.edu.au

The School of Economics has developed specialisations in several fields of applied economics including project evaluation and cost benefit analysis, transport economics, public finance, regional and urban studies, applied econometric analysis and economic model building. Other areas of interest to the School include development economics, natural resource utilisation, environmental economics, science and technology policies, information economics research, macroeconomics and monetary economics.

**CONSULTING SERVICES:**

* economic impact analysis at state and regional level
* regional and urban economic planning and policy issues
* local government economic planning
* general microeconomic analysis
* industry studies
* health services research
* economic evaluation studies
* cost benefit analysis
* economic modelling and testing
* macroeconomic forecasting
* statistical package instruction
* economic analysis of Queensland economy and Queensland economic policy
* natural resource and environmental economics including marine resource economics and aquaculture
* labour economics
* science technology and information policy
* information economics and economics of technological change
* input-output impact studies
* managerial economics
* economics of tourism
* development economics in the Third World - Asian Pacific Economics

**Research units within the School include:**

**Regional and Urban Economics Research Unit** *(Director: Professor Rod Jensen)*
This unit was formed to co-ordinate activities appropriate to research and the dissemination of ideas on regional and urban economics. The Unit has particular strengths in regional and urban modelling, policy and planning.

**Resources Environment and Development Research Unit** *(Director: Associate Professor George Docwra)*
This unit was formed to carry out research into all aspects of economic and environmental policy formation with particular, but not exclusive, focus on Queensland and Australia, centring on issues which involve natural resources.

**Queensland Economic Policy Research Group** *(Director: Dr. Tom Riha)*
The program is concerned with research into any aspect of Queensland economy - but especially with critiques of government policy, restructuring of the economy in the light of changing world trade circumstances, public finance, and aspects of federalism.

# COMPARING BATSMEN ACROSS DIFFERENT ERAS: THE ENDS OF THE DISTRIBUTION JUSTIFYING THE MEANS

H. Shelton Brown
School of Economics
The University of Queensland
Brisbane Qld 4072
s.brown@economics.uq.edu.au

May 2001

Discussion Paper No 289

ISSN 1033-4661

# Comparing Batsmen Across Different Eras: The ends of the distribution justifying the means[†]

by

H. Shelton Brown, III[††]

School of Economics

The University of Queensland

**Abstract**

The debate over the quality of modern batsmanship in cricket parallels the debate over the disappearance of the 0.400 hitter in baseball. This paper shows that as bowling and fielding skills have improved over time, the best batting averages in cricket, which are in the right tail of the distribution of all batting averages, have declined. This does not imply poorer batting skills. Both decadal standard deviations and coefficients of variation reveal wider variations in batting averages in previous decades, especially the 1940's. The batting average actually measures batting skill in relation to bowling and fielding skills, the later of which, it is argued, have improved over time. Therefore, by mistakenly interpreting the batting average as an absolute measure of batsmanship, cricket experts and fans under-appreciate the skill of modern batsmen. The paper attempts to make a meaningful comparison of modern batsmen to non-modern batsmen through use of the $Z$ transformation.

[†]The author would like to thank Darrel Doessel, Averil Cook and numerous other cricket fans I was able to trap in the hallway of the School of Economics.

[††]Mailing Address: School of Economics, The University of Queensland, St. Lucia, Qld 4072 AUSTRALIA; phone: +61-7-3365-6470; fax: +61-7-3365-7299; e-mail: s.brown@economics.uq.edu.au

# 1 Introduction

For those who do not understand batting in cricket, a brief description is given in Appendix 5.

When the Australian team of the century was announced last year, 5 of the 12 players were from Sir Donald Bradman's 1948 "Invincibles". While unenlightened non-Australian observers, such as myself, might wonder whether a single team out of 100 deserves 42% of picks, the *Sydney Morning Herald* (January 19, 2000) article commented that "Don Tallon, the wicket keeper of the [Invincibles] era, who was a significant omission when excluded for another Queenslander in Ian Healy." Given the recent success of the Australian team, as well as the general belief that athletic achievement has improved over time, it is curious that so many players, especially batsmen, from previous eras were selected. It is even more surprising that the decision is universally accepted. Other countries that play cricket also seem to have an anti-modern bias as well. Wisden's (April 2000) poll of 100 international cricket experts reveals that few modern international players make the all-century team (see Table 1).

It seems that the bias is strongest against modern batsmen, where modern is loosely defined as 1970-. Modern "all rounders", or players that both bowl and bat, bowlers, and great fielders are more likely to make the top lists of the century. Table 1 shows that only one modern batsman, Sir Vivian Richards, made top 15 of the Wisden list. No batsman who played in the last 20% of the century made the list.

Having lived in Australia for over 2 years, I have learned that cricket fans take great

Table 1: Wisden Top 15 Test Cricketers

| Player | Votes |
|---|---|
| 1. Sir Donald Bradman† | 100 |
| 2. Sir Garfield Sobers† | 90 |
| 3. Sir Jack Hobbs† | 30 |
| 4. S K Warne | 27 |
| 5. Sir Vivian Richards† | 25 |
| 6. D K Lillee | 19 |
| Sir Frank Worrell | 19 |
| 8. W R Hammond† | 18 |
| 9. D C S Compton | 14 |
| 10. Sir Richard Hadlee | 13 |
| Imran Khan | 13 |
| 12. S M Gavaskar† | 12 |
| 13. S F Barnes | 11 |
| Sir Leonard Hutton† | 11 |
| 15. W J O' Reilly | 10 |
| †Made the list of the top batsmen, as given in Tables 2 and 3 | |

pride in emphasiz(s)ing differences between cricket and baseball. However, the historical statistical patterns for batters and batsmen are quite similar. In cricket, the highest average for test cricket in the 1990's was 58.4 (WW Hinds of the West Indies in 8 innings), yet several players in the 1940's averaged almost twice that (see column 3 of Table 2). In baseball, no one in the major leagues has hit 0.400, or made at least a hit (a single, a double, a triple, or a home run) in 40% of the batter's trip to the plate, since 1941, when T Williams of the Boston Red Sox hit 0.412. In both sports, fans have concluded that hitting isn't what it used to be (see Gould (1996) for evidence in the basball case).

It is remarkable how similarly cricket and baseball fans interpret, or mis-interpret, batting averages. Both baseball and cricket fans may be emphasizing central tendency at the expense of variation. In both cases, batting average is used as an absolute standard to measure a particular player's hitting ability. As Gould (1996) points out in basball, batting average is not an absolute measure in the same sense as a 100-meter freestyle time.

If pitching and fielding improve greatly relative to batting, the best batting averages, which appear in the right tail of the distribution of all batting averages, will decline, even if great hitting remains the same or slightly improves. In contrast, it is unlikely that future swimmers will not be able to at least match the best times of today because swimmers compete against the clock using the most modern techniques and training; hitters and batsmen compete against fielders and pitchers and bowlers, respectively, *all* of whom use the most modern techniques and training. If fielding, pitching, and bowling improve relative to batting, the best hitters and batsmen of a later era will not be able to match the batting averages of the averages from an earlier era.

In the case of cricket, the decline in the top batting averages in the post-war era is dramatic. As pointed out earlier, the highest average for test cricket in the 1990's was 58.4 by WW Hinds in 8 innings. From 1940-1949, 16 of 171 players who batted at least one innings exceeded that average. Thus, if one believes batting average should be used as an absolute measure, then he must believe that over nine percent of the test cricketers in the forties were better than the best batsmen from 1990-1999. The "older is better" school seems to want to compare Bradman to modern batsmen. Conceding that Bradman is the best, what about the other 15 batsmen from the forties with higher batting averages? The fact that 10 of the 16 batsmen from the forties who had a 58.4+ average had.3 or less innings only highlights the disparity in the quality of play between the 1990-1990 period and the 1940-1949 period. Not a single batsman with 3 or less innings in the nineties had a 58.4+ average.

Briefly, the lower batting averages in the right tail of the distribution are likely caused by improved fielding and bowling. First, as Gould (1996) points out, in a system such

as cricket where there are few rule changes, skill and strategy improve over time and are taught to future generations. In cricket, coaching has improved, especially for youths. Defensive strategies that work are adopted over time. Secondly, he players in test cricket are drawn from a much larger population and from more countries than ever before. Thus, given that great arms are natural (even if they do not always make good bowlers), it is more likely that the average bowler has a great arm if they are drawn from a large population. It is the case that most test cricket sides now have multiple fast bowlers, which means fresher arms in comparison to previous decades.

Although the rules and conditions of international test cricket have been stable over time, there have been some changes. First, pitches are now covered during rainy periods. Second, batsmen now wear helmets, which should favor batsmen because of an increased feeling of security. However, it may also invite brazenness on the part of bowlers because they have less fear of harming the batsman. Third, ship travel has been replaced by flying, which greatly reduces the fatigue. Although this may appear to be a neutral change, it likely favors the defense because the fielders *and* bowlers are fresher. There are many other changes that one could cite.

I again borrow Gould's argument for baseball. Over time, rulemakers seek to balance advantages for bowlers with advantages for to batsmen. After 1890, the mean batting average for all batsmen varies between approximately 18 and 25, which is relatively stable. Therefore, neither the defense nor the offense has wholly won out over time.

## 2 Results

In the case of baseball, Gould (1996) showed that over time, as fielding and pitching improved relative to batting, the distribution of batting averages has continuously shrunk in both the left and the right tails. To show this, he calculates decadal mean batting averages along with their standard deviations. This analysis will replicate Gould's analysis for cricket.

Only international test cricket averages are considered. One day cricket is excluded for two reasons. First, one day rules are inconsistent with international test cricket. Second, one day cricket is relatively new, which makes comparisons to previous decades impossible.

The distribution of batting averages in early test cricket, 1876-1889, is given in Figure 1. At this point, only Australia and England played test cricket, so there are few players. Therefore, I combined the late 1870's with the 1880's. I also included everyone that batted at least one innings in any test cricket match during the time period. One could argue, as Gould (1996) does, that I should establish minimum innings.[1] However, I did not do so because in cricket, there are many people who bat only once because there are fewer opportunities in comparison to baseball.

Unlike batting averages in baseball where batting averages are normally distributed, it is clear that the distribution of batting averages in cricket are right-skewed. On the left side of the distribution, no one can do worse than zero, but many batsmen score no

[1]For baseball fans, innings are roughly equivalent to at-bats in baseball. However, if you score a run, you keep going until they get you out or until you voluntarily stop. For cricket fans, an at-bat ends with an out or reaching base. After three outs, the team at-bat takes the field. Switching from fielding to batting takes place 9 times.

runs[2] so there are many batsmen bowled out with no runs. If I excluded batsmen with only a few innings in a decade, it is possible that the distribution might be normal or less skewed.

If one looks at the early period of test cricket from 1876-1909 in Figures 1, 2, and 3, the standard deviation of batting averages declines. If one focuses on the left tail of the distribution, there are fewer poor batting averages in 1900-1909 in comparison to 1876-1889. Even though the mean batting average increases over this period, the right tail shrinks slightly. This is consistent with an improvement in play. There are less poor batsmen, there is better fielding and bowling.

The decline in the early years of test batting averages is most easy to see in the left side of Figure 13. Here the coefficient of variation declines, which means that total variation in batting declines over the period. This analysis uses the coefficient of variation because it relates the standard deviation, which is the "average" difference from the mean, to the overall mean batting average.[3] The coefficient of variation is in percentage form, which is convenient for interpretation. A coefficient of variation value of over 100 is interpreted as average variation being as high as the mean itself. A coefficient of variation taking a value near 0 is interpreted as very low variation.

Figure 13 shows that the coefficient of variation of the batting average increases greatly during the teens, then declines in the between-war era. You don't have to be a historian to understand why variation increases greatly during the teens. Men were needed for the war effort, which surely hurt the level of cricket play.

[2]I almost achieved a negative one-innings average at our student-staff match.

[3]For the mathematically inclined, formula is as follows: $CV = (\sigma/\mu) \times 100$, where the decade mean is given by $\mu$ and the standard deviation is given by $\sigma$. Note that I use population data in this analysis.

Figures 5 and 6 show that in the twenties and thirties, the distribution of batting averages is almost flat.

Figure 1: 1876-1889 Batting Average

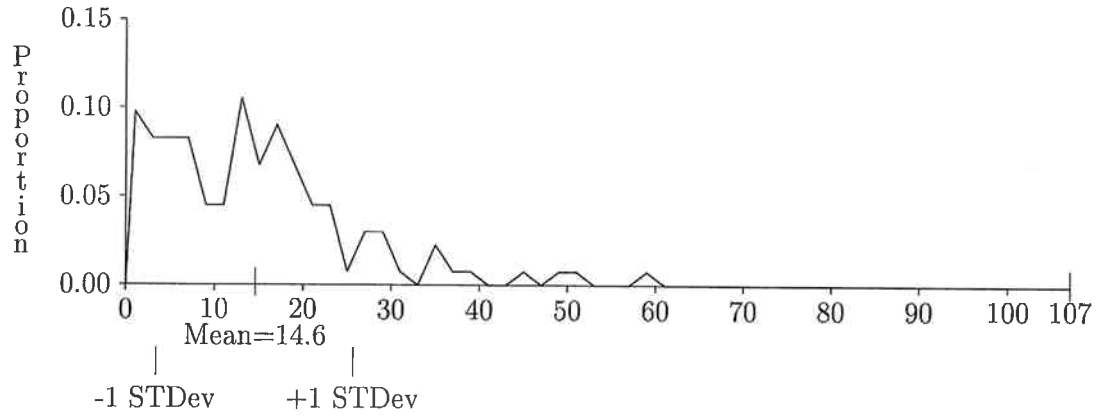



Figure 2: 1890-1899 Batting Average

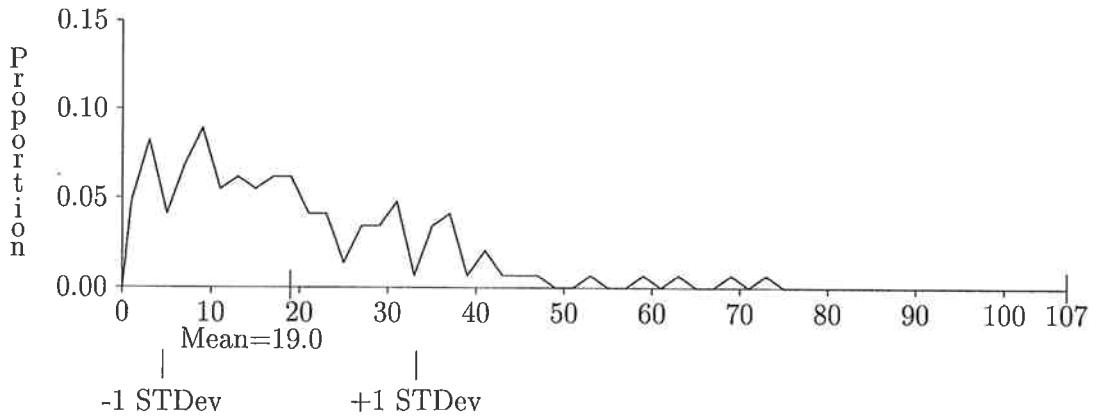



Figure 3: 1900-1909 Batting Average

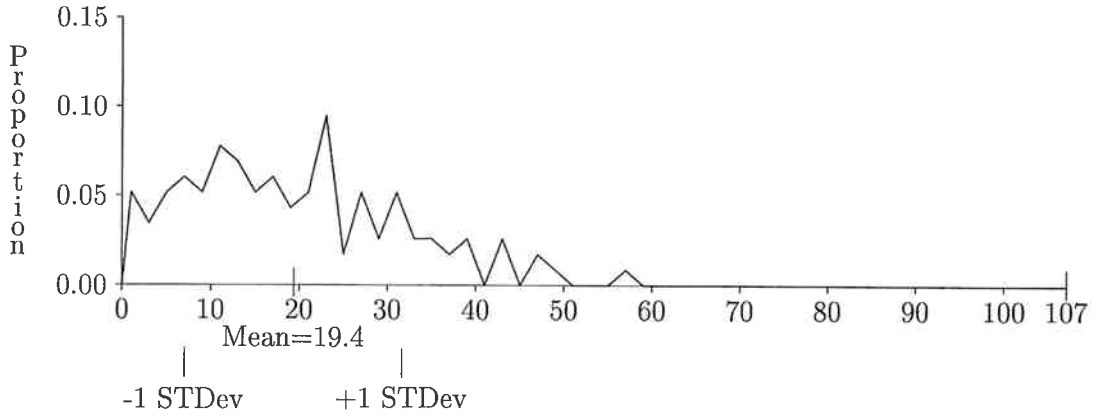


Figure 4: 1910-1919 Batting Average

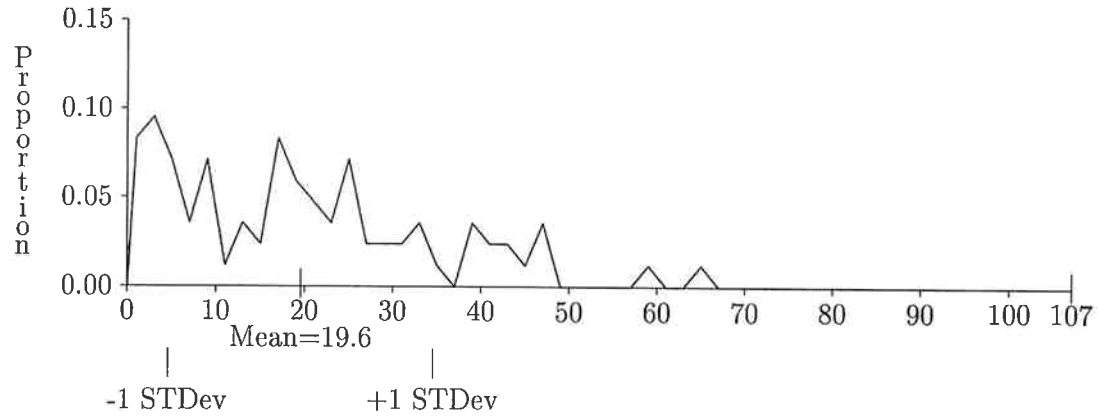



Figure 5: 1920-1929 Batting Average

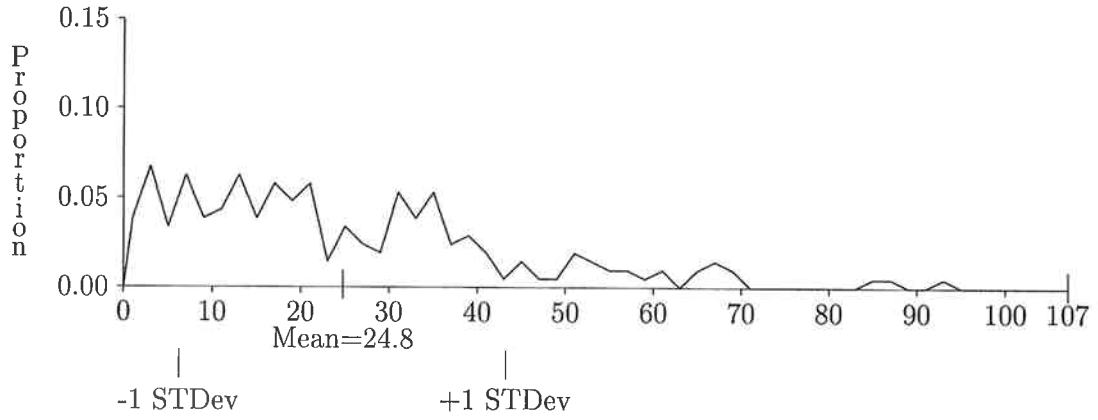



Figure 6: 1930-1939 Batting Average

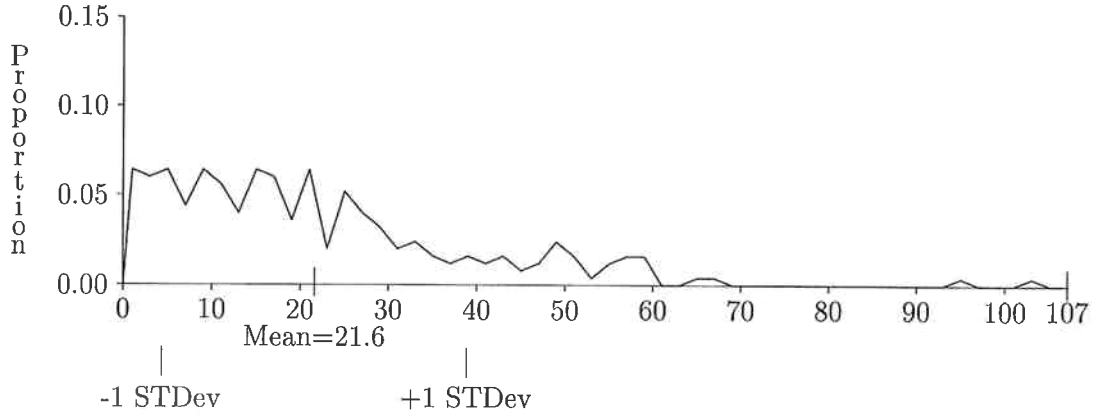


Figure 13 shows that the coefficient of variation of the batting average increases greatly during the two world wars. This supports the thesis of this paper. With fewer players and less coaching due to the war efforts, the tails of the distribution of batting averages grows. Figures 4 and 7 show that there are more poor batsmen (the left side of the two distributions are thick near 0). Poor fielding and bowling during the world wars mean that right tails expand as well.

By comparing Figure 7 with Figure 12, one can see that one standard deviation above the mean is 49 for the forties, but only 33.7 for the nineties. Recall that the maximum average for a single player in the 1990's was just over 58.4.

Note further that during the forties, batting averages exploded in comparison to surrounding decades.

Figure 7: 1940-1949 Batting Average

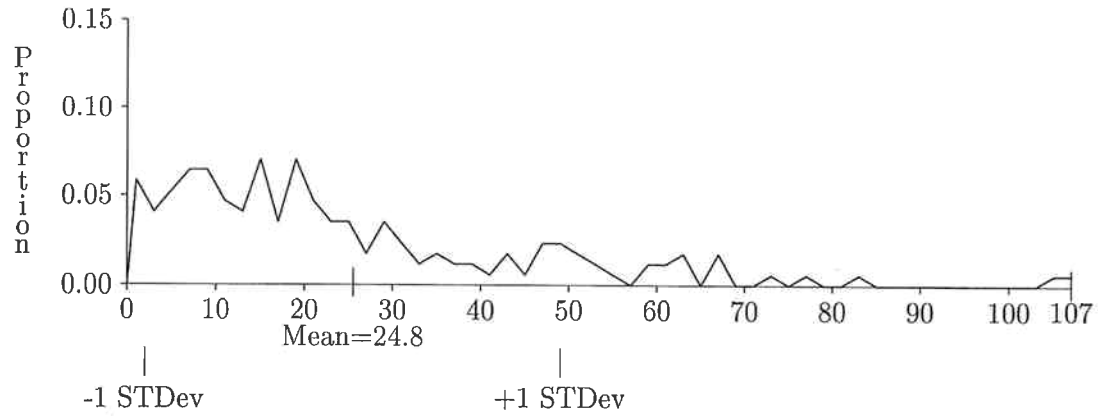



Figure 8: 1950-1959 Batting Average

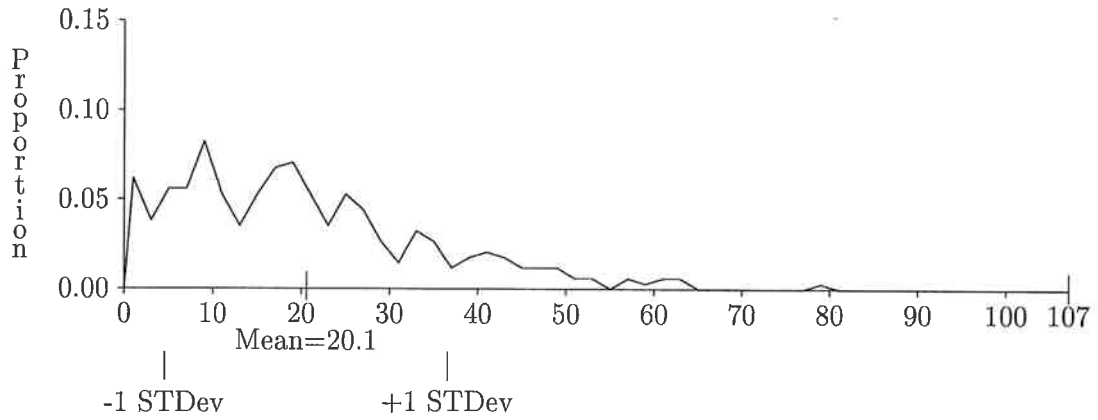



Figure 9: 1960-1969 Batting Average

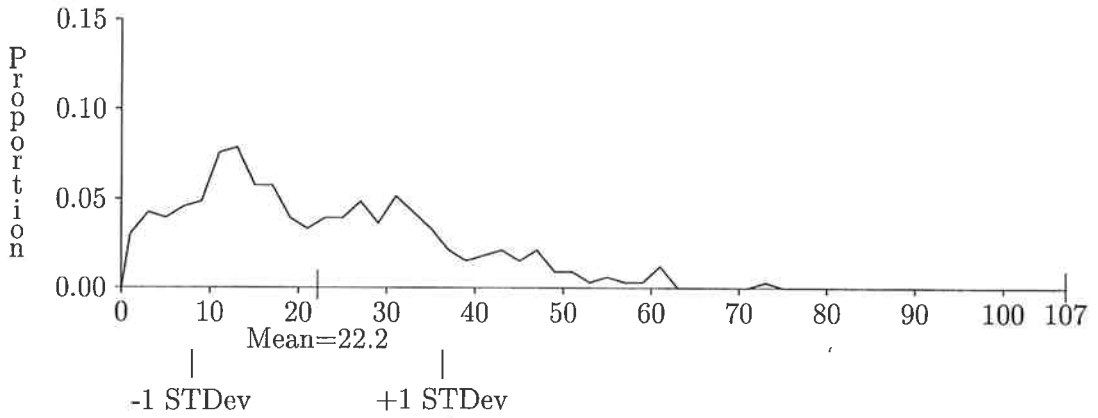


Figure 10: 1970-1979 Batting Average

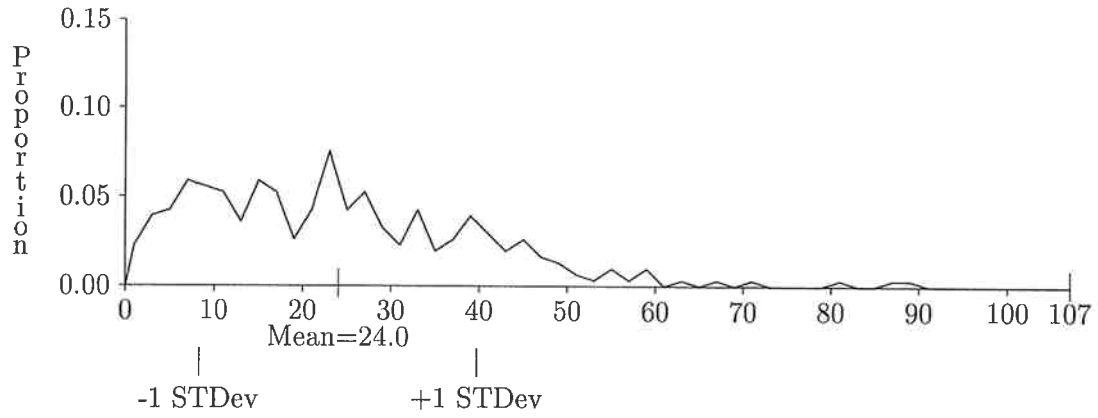



Figure 11: 1980-1989 Batting Average

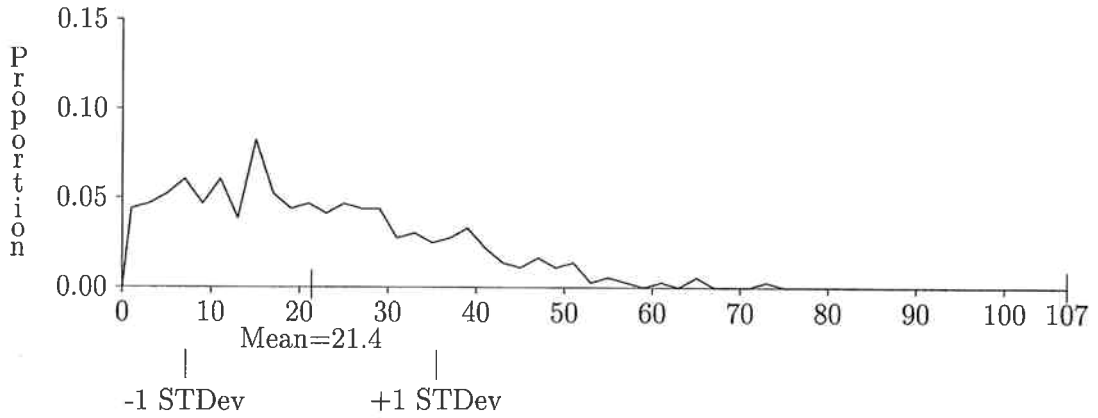



Figure 12: 1990-1999 Batting Average

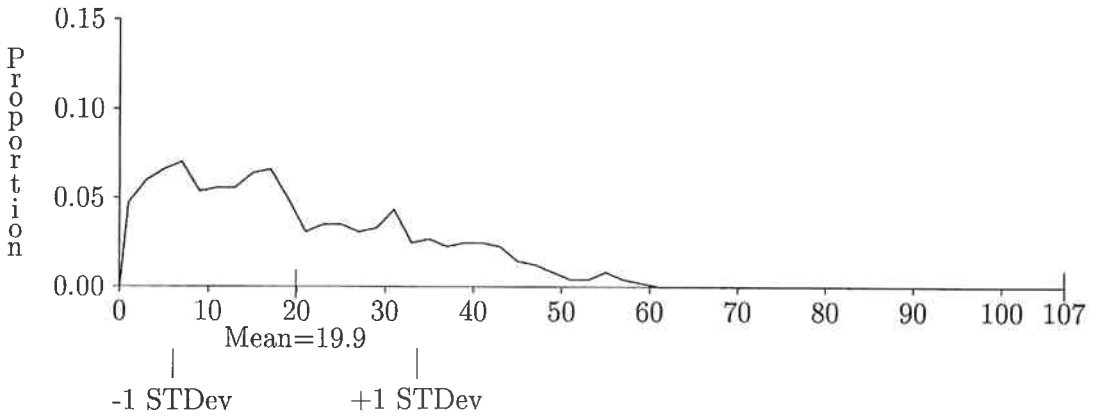
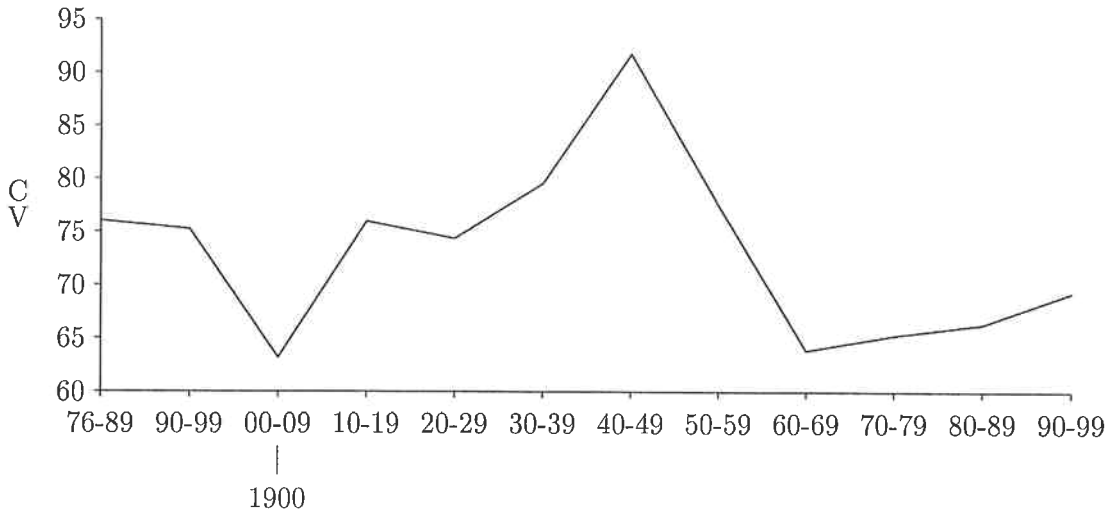


Figure 13: 1876-1999 Batting Average, Coefficient of Variation



## 2.1 A fairer comparison of batsmen from different eras

Clearly, the distribution of batting averages is not stable over the history of cricket. If you agree that the batting average is a relative measure of batting as compared to fielding and bowling rather than an absolute standard, you will agree that the number of standard deviations above the mean for a given era is a superior measure of batsmanship when making comparisons across eras. In this section, a $Z$-score, which is the individual mean less the overall decadal mean divided by the decadal standard error, is calculated for each batsmen in each decade.

Tables 2 and 3 simply rank batsmen for their decade average in test cricket using the $Z$-score. Players can appear twice. If player $Y$ plays in 1949 only and then plays from 1950-1953, player $Y$ theoretically could appear in the ranking twice. This is why Bradman appears twice. In fact, his unadjusted 1930-1939 average, which is lower than his 1940-1949 average, looks much more impressive in comparison to his 1940-1949 average.

SR Tendulkar and MA Taylor are batsmen of the modern era which perhaps deserve attention for their performances in test cricket. Players from the last century, where far fewer runs were scored, also benefit from the wide variability in the forties. C. Bannerman is one example.

Only batsmen with 10 or more innings are included in Tables 2 and 3.

# 3 Conclusion

Batting averages in cricket are not absolute measures of batsmanship across different eras, they are relative measures of batting performance in comparison to bowling and

Table 2: Top Test Cricket Batting Averages by $Z$ score

| Rank | Name | Country | Decade | Ave | Innings | $Z$ |
|---|---|---|---|---|---|---|
| 1 | Bradman, DG | A | 1930-1939 | 102.78 | 49 | 4.71 |
| 2 | Harvey, RN | A | 1940-49 | 106.56 | 13 | 3.46 |
| 3 | Bradman, DG | A | 1940-49 | 105.72 | 23 | 3.42 |
| 4 | Jackson, FS | E | 1900-1909 | 57.36 | 17 | 3.10 |
| 5 | Taylor, MA | A | 1980-1989 | 64.72 | 27 | 3.06 |
| 6 | Hobbs, JB | E | 1910-1919 | 64.87 | 26 | 3.04 |
| 7 | McLeod, CE | A | 1890-99 | 59.63 | 12 | 2.85 |
| 8 | Greatbatch, MJ | N | 1980-1989 | 61.69 | 17 | 2.85 |
| 9 | Barrington, KF | E | 1960-1969 | 60.99 | 113 | 2.74 |
| 10 | Pollock, RG | SA | 1960-1969 | 60.97 | 41 | 2.74 |
| 11 | Tendulkar, SR | I | 1990-1999 | 57.62 | 111 | 2.74 |
| 12 | Davis, CA | W | 1970-1979 | 66.56 | 21 | 2.71 |
| 13 | Alexander, FCM | W | 1960-1969 | 60.5 | 10 | 2.71 |
| 14 | Gilchrist, AC | A | 1990-1999 | 57.18 | 14 | 2.71 |
| 15 | Sobers, GStA | W | 1950-1959 | 63.52 | 54 | 2.69 |
| 16 | Hutton, L | E | 1930-1939 | 67.25 | 21 | 2.65 |
| 17 | O'Neill, NC | A | 1950-1959 | 62.57 | 19 | 2.63 |
| 18 | Walters, KD | A | 1960-1969 | 59.21 | 42 | 2.62 |
| 19 | Trumper, VT | A | 1910-1919 | 58.13 | 19 | 2.59 |
| 20 | Waugh, SR | A | 1990-1999 | 55.09 | 144 | 2.55 |
| 21 | Kambli, VG | I | 1990-1999 | 54.2 | 21 | 2.49 |
| 22 | Ranjitsinhji, KS | E | 1890-99 | 53.89 | 22 | 2.45 |
| 23 | Javed Miandad | P | 1970-1979 | 62.38 | 51 | 2.44 |
| 24 | Walcott, CL | W | 1950-1959 | 59.5 | 60 | 2.44 |
| 25 | Macartney, CG | A | 1920-1929 | 69.56 | 21 | 2.43 |
| 26 | Weekes, EdeC | W | 1940-49 | 82.46 | 13 | 2.43 |
| 27 | Lloyd, CH | W | 1980-1989 | 55.68 | 53 | 2.42 |
| 28 | Gower, DI | E | 1990-1999 | 53 | 21 | 2.40 |
| 29 | Hobbs, JB | E | 1900-1909 | 48.65 | 23 | 2.39 |
| 30 | Sobers, GStA | W | 1960-1969 | 55.86 | 78 | 2.38 |
| 31 | Gooch, GA | E | 1990-1999 | 51.9 | 79 | 2.32 |
| 32 | Hammond, WR | E | 1920-1929 | 67.56 | 29 | 2.32 |
| 33 | Javed Miandad | P | 1980-1989 | 54.04 | 107 | 2.31 |
| 34 | Lara, BC | W | 1990-1999 | 51.6 | 112 | 2.30 |
| 35 | Rowan, EAB | SA | 1950-1959 | 57.22 | 10 | 2.29 |
| 36 | Border, AR | A | 1980-1989 | 53.79 | 161 | 2.29 |
| 37 | Hutton, L | E | 1950-1959 | 56.84 | 66 | 2.27 |
| 38 | Umrigar, PR | I | 1960-1969 | 54.05 | 22 | 2.25 |
| 39 | Richards, IVA | W | 1970-1979 | 58.9 | 51 | 2.22 |
| 40 | Hammond, WR | E | 1930-1939 | 59.7 | 98 | 2.21 |

Table 3: Top Test Cricket Batting Averages by $Z$ score, part 2

| Rank | Name | Country | Decade | Ave | Innings | Z |
|---|---|---|---|---|---|---|
| 41 | Headley, GA | W | 1930-1939 | 59.67 | 27 | 2.21 |
| 42 | Foster, RE | E | 1900-1909 | 46.31 | 14 | 2.20 |
| 43 | Paynter, E | E | 1930-1939 | 59.23 | 31 | 2.18 |
| 44 | Shoaib Mohammad | P | 1990-1999 | 49.73 | 26 | 2.17 |
| 45 | Ramesh, S | I | 1990-1999 | 49.59 | 18 | 2.16 |
| 46 | Sutcliffe, H | E | 1920-1929 | 64.35 | 50 | 2.15 |
| 47 | Jones, DM | A | 1980-1989 | 51.71 | 59 | 2.14 |
| 48 | Graveney, TW | E | 1960-1969 | 52.09 | 47 | 2.11 |
| 49 | Chappell, GS | A | 1980-1989 | 51.13 | 44 | 2.10 |
| 50 | Zaheer Abbas | P | 1980-1989 | 51.06 | 53 | 2.10 |
| 51 | Weekes, EdeC | W | 1950-1959 | 53.7 | 68 | 2.07 |
| 52 | Gavaskar, SM | I | 1970-1979 | 56.36 | 114 | 2.06 |
| 53 | Simpson, RB | A | 1960-1969 | 51.22 | 84 | 2.05 |
| 54 | Matthews, GRJ | A | 1990-1999 | 48.12 | 19 | 2.05 |
| 55 | Duleepsinhji, KS | E | 1930-1939 | 56.73 | 11 | 2.04 |
| 56 | Kanhai, RB | W | 1960-1969 | 50.96 | 68 | 2.03 |
| 57 | Manjrekar, SV | I | 1980-1989 | 50.06 | 19 | 2.03 |
| 58 | Jones, AH | N | 1980-1989 | 49.86 | 25 | 2.01 |
| 59 | Boon, DC | A | 1990-1999 | 47.6 | 102 | 2.01 |
| 60 | Ponting, RT | A | 1990-1999 | 47.51 | 53 | 2.00 |

A Australia
E England
I India
N New Zealand
P Pakistan
SA South Africa
W West Indies

fielding. As Gould (1996) showed for baseball, batting performance, when measured by raw batting averages, will appear to decline as fielding and bowling improve over time. The coefficient of variation of batting averages is quite high in the eras of legendary performance, especially in the 1940's. Modern batsmen, when incorrectly compared to batsmen of yesteryear, do not get the respect they deserve.

I have argued, and then not offered evidence, that bowling and fielding have improved. I believe that it has, but I leave it to others to demonstrate this. Cricket statisticians do not keep records on errors.

# 4 References


Gould, Stephen Jay (1996). *Life's Grandeur*, Random House Australia (Pty) Limited, Sydney.

Scholefield, Peter (1990). *Cricket Laws & Terms*, Axiom Publishing, Kent Town, South Australia.

–.*Sydney Morning Herald.* "Greatest of mates," January 19, 2000

Test Cricket (Professional) software, Cricketworld, 2001.

Wisden. "Five Cricketers of the Century: Bradman reigns supreme," April, 2000 Available from: -http://www.wisden.com/ [Accessed 13 Feb 2001]

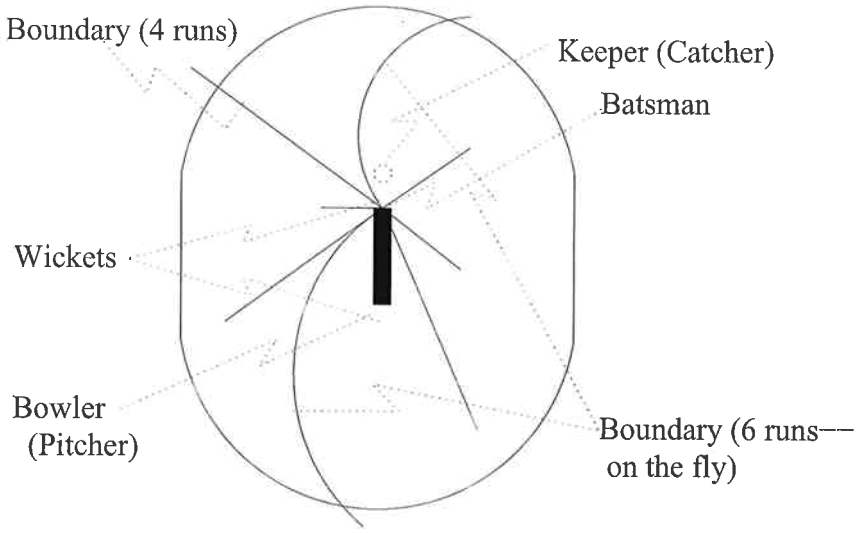



Figure 14: The Cricket Oval.

# 5 Appendix: Cricket batting

What follows is a *very* brief description of batting in cricket. The reader should have some knowledge of baseball. For a more detailed description of the rules, see *e.g., Cricket Laws & Terms* (Scholefield 1990).

There are some major differences between baseball and cricket. In fact, cricket is almost as close to tennis as it is to baseball. Unlike baseball, where runs are rare, in cricket, outs are rare. Cricket batting covers 360 degrees so there is no such thing as a foul ball!

The batsman stands at one end of the "pitch", or the solid rectangular area in the center of the oval, as illustrated in Figure 14. The ground on the pitch is quite hard. The bowler, who is positioned at the opposite end of the pitch as the batsman, normally bounces the ball off the pitch to the batsman, intending to hit the "wicket". The wicket consists of three waist-high posts, or "stumps," inserted in the ground where the catcher would be. The wickets are at both ends of the pitch. Positioned between the stumps

are "bails," which fall out if the bowler bowls (or pitches in baseball) the ball past the batsman and it hits the wicket. This very much like a strike in baseball, except that you are out with one strike. This is very difficult to do. Because the cricket ball is smaller than a basball and that the bat is much larger, this may only happen 3 times in an entire day. No balls and strikes are called. No steals are permitted, freeing the bowler to run up to the edge of the pitch like a long jumper.

As in baseball, the objective for the offense is to score runs. Runs can be scored in three main ways. First, as illustrated in Figure 14, the batsman may hit the ball *in any direction* and then run back and forth between the wickets. Each wicket reached is a run. If the ball hits the wicket while either batsmen is running between them, he is out. One of the 11 defenders would filed the ball and either throw it to the keeper or at the stump itself. This is called "run out." As in baseball, if a hit ball is caught on the fly, the batsman is out. Second, if the ball rolls all the way to the "boundary," or the outer edge of the oval illustrated in Figure 14, 4 runs are awarded. As with runs, the hit can be in any direction. Third, if the ball lands past the boundary on the fly, as illustrated in Figure 14, 6 runs are awarded.

The other major way to get out is if a bowled ball hits either of your legs (you've got pads!) when you do not try to hit the ball and when you are directly in front of the wicket. The umpire must rule that the ball would have hit the wicket. This is called an LBW, or leg before wicket.

Even if they just scored a run, cricket batsmen keep going until they are out or if the captain voluntarily stops the innings.[4] The batting average is the number of runs you

[4] "Innings" is both plural and singular.

score per innings, which is roughly the number of times you go to the plate.

**DISCUSSION PAPERS IN ECONOMICS - PUBLISHED TO DATE**
*(A complete list of Discussion Papers in Economics is available upon request.)*

274. **Xue, D., Cook, A. & Tisdell, C.,** *Biodiversity and a travel cost evaluation of tourism: the case of Changbaishan Mountain Biosphere Reserve, China*, April 2000.

275. **McAllister, R., Beard, R. & Asafu-Adjaye, J.**, *Control Model of Illegal Logging by Commercial Logging Contractors in Laos PDR*, July 2000.

276. **Collins, D. & Tisdell, C.,** *Travel Life Cycles Vary Significantly with the Purpose of Travel*, July 2000.

277. **Wilson, C.,** *The Private Costs of Exposure to Pesticides in Sri Lanka: Estimates from Three Valuation Techniques*, July 2000.

278. **Donnelly, L.B. & Doessel, D.P.,** *A Temporal and Spatial Analysis of Relative Prices for General Practitioner and Specialist Services in Australia, 1984-1996*, September 2000.

279. **Drew, M.E. & Stanford, J.D.,** *Returns from Investing in Australian Equity Superannuation Funds, 1991 to 1999*, October 2000.

280. **McDonald, S., Beard, R. & Purcell, T.,** *How About Tomorrow? Optimal Procrastination And The Implications For Delay In Submitting to Conferences*, November 2000.

281. **McAllister, R. & Bulmer, M.,** *Approximating Difference Game Open-Loop Steady States Using Reiterative Genetic Algorithms,* December 2000.

282. **McAllister, R. & Bulmer, M.,** *Forest Property Rights Enforcement in Lao PDR: A Steady State Analysis Using Genetic Algorithms*, December 2000.

283. **Campbell, H.F.,** *Aboriginal Land Rights and Mineral Exploitation in Australia*, December 2000.

284. **Brown, S.**, *Managed Health Care and Technical Efficiency in the USA*, January 2001.

285. **Cook, A. & Freeman, B.**, *Effectiveness of PASS and Tutorials in EC135*, February 2001.

286. **Cook, A.**, *Flexible Assessment of EC135*, February 2001.

287. **Tang, K.K. & Tseng, Y-P**, *Inter-Industry Wage Differential and Specific Human Capital,* April 2001

288. **Karunaratne, N.D.**, *The Issue of Capital Account Convertibility – A Post Currency Crisis Perspective*, May 2001.

**PUBLICATIONS IN THE *ECONOMICS CONFERENCE MONOGRAPH SERIES* OF THE SCHOOL OF ECONOMICS**

No 1 *Bangladesh: Economy, People and the Environment*
(Editors: M. Alauddin and S. Hasan), pp.xx + 403

No 2 *China's Economic Growth and Transition*
(Editors: C.A. Tisdell and J.C.H. Chai), pp.viii + 526

No 3 *China and the Asia Pacific Economy*
(Editors: J.C.H. Chai, Y.Y. Kueh and C.A. Tisdell), pp.viii + 467

No 4 *Evolving Communication and Socio-Economic Change: STEP 1996*
(Editors: D. Anthony, T. Mandeville and J. Foster), pp.iv +108

No 5 *Fifty Years of Indian Development: India in Retrospect, Future Directions and Investment Outlook*
(Editors: P.K. Basu, N.D. Karunaratne and C.A. Tisdell), pp.xiii + 170

No 6 *Facets of Development of Sri Lanka Since Independence: Socio-Political Economics, Scientific and Cultural*
(Editors: W.D. Lakshman and C.A. Tisdell), pp.ix + 387.

*The above titles are available at very reasonable prices while stocks last.*

Note: The School of Economics also publishes a *Discussion Papers* series, which consists usually of more technical papers. Details are available from the Publications Officer at the address below with whom orders may also be placed for both *Discussion Papers in Economics* and the *Economics Issues* series.

Publications Officer
School of Economics
The University of Queensland
Brisbane Qld 4072 Australia
Phone: 61 7 3365 4482
Facsimile: 61 7 3365 7299
Email: a.lindley@economics.uq.edu.au